

Emulating Physical Materials with Pulsed Free-Electrons for Substantially Improved Pulsed Photonic LASER Intensity - Synthetic-Mirror Free-Electronic Photon Accumulator

24 October 2023

Simon Edwards

Research Acceleration Initiative

Introduction

Pulsed LASERs are capable of generating light of intensities that far exceed that of continuous beam LASERs, with applications including fusion research, LASER epitaxy, as well as pure research applications. As powerful as these systems have become, there continues to be niche demand for superior levels of photonic output for certain applications. Adding the ingredient of transverse free electrons (generated by an entirely different type of LASER) to a pulsed photonic LASER system promises to create new possibilities for the field of optics.

Abstract

Although light may, in theory, be accumulated between two physical mirrors as a means of accumulation, there exists no reflective material capable of maintaining its structural integrity when exposed to light of intensities associated with terawatts of energy. No reflective surface is perfectly reflective, meaning that all materials, however reflective, absorb and therefore convert into heat a portion of the light that interacts with it.

The reflective property of a material, as with nearly all material properties, is determined solely by the number and configuration of the electrons of the atoms of which they are composed. Through the creative use of highly collimated Free-Electron LASERs, constellations of repeating patterns of electrons emulating specific materials may be introduced to a physical space so as to act as a solid object, at least vis a vis its influence on photons. From the perspective of photons, it makes no difference whether electrons are orbiting a nucleus or whether they are in linear motion during the time of interaction. When a photon is reflected by a material, Coulomb forces of many electrons aligned in the direction of travel of the photon, resulting in an instantaneous inversion of the direction of travel upon a photon's coming into sufficient proximity to a sufficiently forceful Coulomb Force Line. Photons are not being, "absorbed and re-emitted" as is widely believed. It is puzzling that the notion of light needing to be absorbed and re-emitted in order to be reflected is being taught in schools as fact when it is well-known that nuclear resonance results in conversion of light into heat and photon-electron conversion results in cationization. Furthermore, it is not in any way necessary for those electrons that drive the reflection process to be orbiting anything at the time of interaction in order for them to reflect light. The only thing that is required is that those electrons are aligned and that Coulomb Forces are sufficient to invert the angular momentum of the light.

If one imagines a classical mirror composed of polished glass, they may consider the fact that regardless of the motion of the mirror, light will continue to reflect from it in the same way that it would if the mirror were stationary. Fire a LASER at a mirror atop a train passing by at relativistic velocities from a transverse direction and light will reflect from it exactly as it would if the mirror were at rest.

Given this premise, it becomes clear that precise configurations of free electrons, despite being in linear motion, can exert influences identical to specific physical materials with optical properties and, given that a nearly endless supply of these electrons may be generated, the corruption of reflective materials often used in certain LASER systems would cease to be an issue.

This opens the door to the implementation of new strategies for increasing the effective intensity of LASER bursts in pulsed LASER emitters through what may be termed a Synthetic-Mirror Free-Electronic Photon Accumulator.

Multiple individual Free-Electron LASER beams (FELs); essentially streams of individual electrons injected into an environment according to a specific repeating pattern; may be used in order to introduce patterns of electrons into a narrow three-dimensional area in patterns emulative of the electron cloud distributions of known reflective materials, ideally those with a beam-collimating effect. These electrons would flow in the transverse direction of the photons entering the accumulator and would form a sort of wall. The Accumulator would consist of two identical Synthetic Walls on either side running parallel with one another and composed of these calibrated free electrons.

Reflective and prismatic materials require, at the least, several atomic thicknesses of a materials in order to achieve the desired effect, meaning that additional clusters of beams would be needed in order to emulate a three-dimensional physical material. Widening the wall of electrons, however, would be relatively simple, given that repetition of pulse sequences would be all that is required in order for each individual electron to simultaneously contribute to the entire width of each wall.

Rather than a two-way mirror, which, as a physical object, absorbs too great a proportion of light passing into a light accumulator, a Synthetic Mirror would have as its advantage the ability to allow for the injection of photons into the accumulator that pass directly through the walls during the brief periods in which the walls are "not there." During this brief window, the exact duration of which is determined by the distance between the Synthetic Mirrors, photons may be added at times when the system knows the wall will be "down" with the system re-establishing that wall before photons bounce back to the wall so as to ensure their continued recursive reflection within the accumulator.

Whereas the Synthetic Mirror on the photonic LASER's side of this chamber would be disabled during dozens of brief windows in each cycle so as to allow additional light into the accumulator, the Synthetic Mirror on the "exit aperture"

side would be "let down" a with far lesser frequency, being disabled only a single time when an extremely intense LASER pulse emission is desired.

Although the light would tend to dissipate to a certain extent as it travels between the mirrors, this rate of dissipation would fall well-short of the rate of accumulation. As any material can be emulated by the Tailored Free Electron Wall (TFEW,) a high-degree of control over the collimation and angular momentum of the beam may attained.

Conclusion

The ability to physically accumulate photons outside of the primary LASER mechanism and forward of the primary aperture represents a great leap forward for the State of the Art and is the logical next-step in high-powered pulsed LASER development.